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Avatar Expressions with Scherer's Theory

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Abstract. Progress in computer graphics over the last decade has rendered the creation of believable anthropomorphic graphical avatars possible. Issues in rendering these animated graphical avatars believable and engaging during Human-Computer Interaction still remain. In this current work, we focus on the animation of avatar's facial expressions from a commercially a available generator software (Haptek, www.haptek.com). We created our animation basing on Scherer's theory of emotion because we want to be able to dynamically link internal emotion-like states to external emotional expressions. We have created five facial expression animations (happiness, disgust, sadness, fear and anger) and we discuss the specific steps and issues we followed as well as the evaluation results of a user study we conducted.

1 Haptek avatars

Haptek tools have been developed to generate believable human faces and enable the insertion of avatars in applications and web pages. Haptek animation is based on dedicated technology, similar to MPEG-4 FAP (Facial Action Parameters). There are different levels of control over Haptek avatars: from the control of global facial expressions, morph and position of the avatar to the control of basic facial movements. We use this last feature for developing our facial expressions.

2 Overview on Scherer psychological theory

We based our work on Scherer's multi-level process theory of emotions. According to Scherer's theory (1987, 2001), emotions are experienced depending upon the result of the individual's evaluation or appraisal of the events surrounding him in terms of their significance for one's desires and aversions. Scherer describes this process of appraisal as a process of sequential evaluation of parameters called *Sequential Evaluation Checks* (SECs).

For some of these SECs Scherer's theory gives predictions about the corresponding facial expressions in terms of Ekman's (1978, 2002) facial Action Units (AUs)[1].

Combining properly these predictions, it is possible to, on the one hand, recognize displayed emotions, and on the other hand display facial expressions, not in terms of a label (happiness, sadness etc.) as many computational animations do, but rather in terms of the underlying SECs structure of the emotion.

[1] AUs are defined as the smallest independent facial muscle mouvement/action possible in the human face

3 Avatar Animation based on Scherer's SECs

It is not straightforward to automatically convert SECs to Haptek parameters, and we have identified four steps for the process: 1) convert each SEC to AUs; 2) convert AUs to Haptek parameters; 3) find appropriate intensities for the AUs; 4) exploit the temporal and intra-SEC correlation adapting AUs intensities.

The main issues arises during this last step as we were not able to find information about intra-SEC or temporal (infra-SEC) correlations; i.e. about how sub-expressions are linked to each other over time or how long one single sub-expression should last on the face before it vanishes. We managed this issue referring to standard videos contained in a database of different actors expressing six universal expressions (Ekman 2002). As it became evident that some AUs must be activated in time over different SECs and have their intensities reduced in a fluid way, we relaxed the constraints over AU intensities and adapted the intensity to reach fluid expressions. The transitions for *fear* are shown in Fig. 1.

Fig. 1. Possible evolution of the expression for Fear according to Scherer theory

4 Recognition and Believability Evaluation User Study

We conducted a user study to compare the resulting expressions against the ones of human actors and generic expressions developed by Haptek. The 16 subjects were first asked to recognize the shown emotion (happiness, disgust, sadness, fear and anger), using a closed questionnaire and then to express their opinion, by chosing a mark between 1 and 5, about the expressions shown by one actor, an avatar tuned by standard Haptek expressions and another tuned with the designed parameters.

The recognition scores are good in that the shown emotions were recognized in the 94% of the cases and the believability of the developed expression has been judged in a similar way to the one of human expression and of the Haptek default expressions.

5 Conclusions

This study shows the feasibility of facial emotion expression based on Scherer's component process theory (as Kaiser et al., 2001). Expressions created through this paradigm have shown to be believable and recognizable. Nevertheless this study has shown open research questions regarding the *adaptation* of Scherer's emotion theory for computational modeling.